

## Migration of geogas-carrying gold nanoparticles in Quaternary sediments

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The ascending geogas from the Earth's interior can capture nanoparticles from the ores during passing through ore bodies and deliver them to the surface. Hidden ore bodies may be detected by examining the geogas-carrying nanoparticles in the top of Quaternary sediments [1]. In this study, we investigated the migration behaviors of gold nanoparticles in the Quaternary sediments by means of indoor simulation experiments and field tracer tests. The gold nanoparticles at 20 nm were used in the study. The indoor simulation experiments were designed in which the ascending gas flows with gold nanoparticles flowed through the sediments. The field tracer tests were performed in Shuntian town, Heyuan county, northeast Guangdong Province, China. The gold nanoparticles were laid at the bottom of the sediments and the tests ran for five months. The samples of both the indoor simulation experiments and the field tracer tests, including sediments and particles collected from the gas in the sediments, were analysed by means of instrumental nuclear activation analysis (INAA) and transmission electron microscopy (TEM). The results show that: 1 In the geogas, gold nanoparticles migrate by absorbing on the surface of other particles, or in the form of groups; 2 The gold nanoparticles in the geogas are absorbed by kaolinites, illites, montmorillonites, hematites, goethites, gibbsites, etc., during passing the Quaternary sediments; 3 Gold nanoparticles exist in both gas and solid phases of the Quaternary sediments, and their distribution between the two phases is related to mineral compositions and pHs of the Quaternary sediments.

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### Reference

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## Effects of cobalt on oxide film formation on manganese carbonate

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The fate and the transport of metal contaminants in natural waters are linked with manganese oxide coatings. In the current work, cobalt adsorption and co-precipitation with manganese oxides on manganese carbonate is studied by atomic force microscopy at circumneutral pH. We also investigate how the cobalt ion affects the dissolution of manganese oxide film and  $\text{MnCO}_3$ .

In the presence of  $\text{O}_2(\text{aq})$ , crystallization begins as islands that expand laterally to grow into a film across the surface. The islands have flat tops and are rhombohedral with a uniform thickness of 2.4 nm in the absence of added  $\text{Co}^{2+}(\text{aq})$ . In contrast, a multilayer structure with apparently unrestrained z-directional growth forms in the presence of  $\text{Co}^{2+}(\text{aq})$ . The net macroscopic dissolution rate slows by a factor of two in the presence of  $\text{Co}^{2+}(\text{aq})$ . The normally rhombohedral shape of the dissolution pits of  $\text{MnCO}_3$  is distorted in the presence of cobalt, and  $\text{Co}^{2+}(\text{aq})$  preferably associates with the obtuse steps. Cobalt also affects the dissolution rate of the Mn oxide film. Dissolution of the Mn oxide layer is observed simultaneous to the formation of a second oxide film. The observations are explained by the parallel oxidation of  $\text{Co}^{2+}(\text{aq})$  and reduction of  $\text{Mn}^{\text{III/IV}}$  on the surface. Under this model, a  $\text{Mn}_x\text{Co}_y\text{O}_z$  composition is suggested for the second oxide film. The cobalt adsorption rate ( $\text{mol m}^{-2} \text{s}^{-1}$ ) on the surface increases with the initial  $[\text{Co}^{2+}](\text{aq})$  and with increasing Mn oxide film coverage.

The timing of cobalt addition affects film growth. When no  $\text{Co}^{2+}(\text{aq})$  is added initially, rhombohedral Mn oxide islands nucleate by heterogeneous oxidation on the  $\text{MnCO}_3$  substrate and film growth continues until the entire surface is covered. Adding  $\text{Co}^{2+}(\text{aq})$  disrupts growth of the Mn oxide film and results in the formation of a second  $\text{Mn}_x\text{Co}_y\text{O}_z$  phase. When  $\text{Co}^{2+}(\text{aq})$  is added at the beginning of the experiment, growth of the  $\text{Mn}_x\text{Co}_y\text{O}_z$  phase is predominant, and no evidence of the Mn oxide film is observed.

Direct microscopic observations of the interactions of cobalt with manganese oxide coatings provide new mechanistic insights that are important in the quantitative modeling of the fate and the transport of toxic metals in the environment.